

Surface Erosion Control

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Components of Surface Erosion

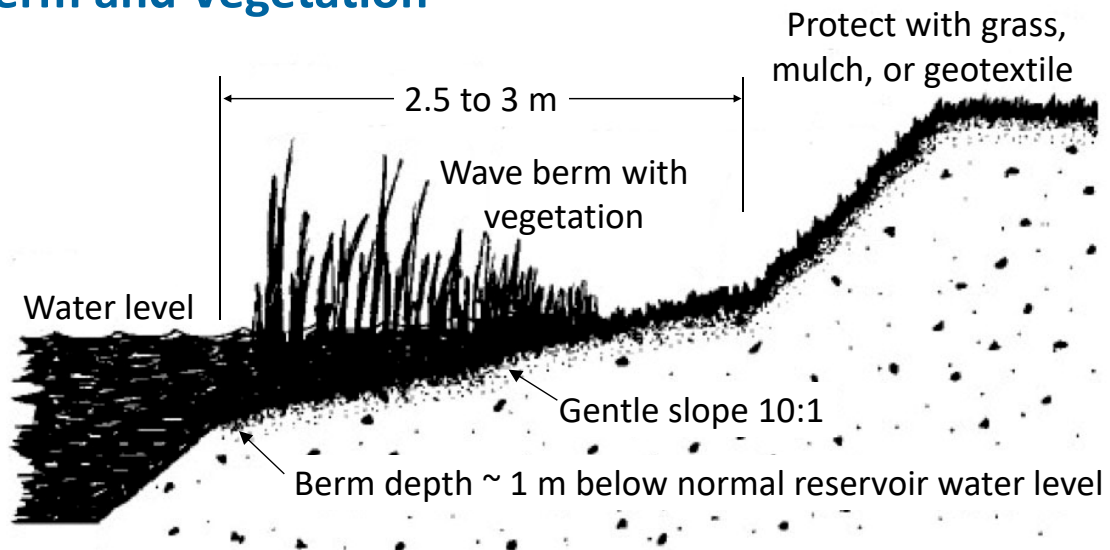
- 1 – Wave erosion
- 2 – Embankment runoff erosion
- 3 – Spillway and ditch erosion

1 - Protection from Waves

- Shoreline berm
- Vegetation
- Rock riprap
- Geotextile
- Booms



Berm and Vegetation



Mother nature does this over time

(Modified from Kansas Department of Agriculture)

4

Riprap

- Easy to install and repair
- Durable and flexible
- Little maintenance required
- May be expensive and impractical if suitable rock not available



https://www.freese.com/sites/default/files/styles/award_image/public/SJR2.JPG?itok=zis_3HTh

5

Rocks for Riprap

- Heterogeneous mixture of irregular shaped, angular rocks of sufficient size
- Use rock resistance to deterioration from weathering



<http://www.sempertekinc.com/wp-content/uploads/photo-gallery/DSCF1495.JPG>

6

Recommended Riprap Size

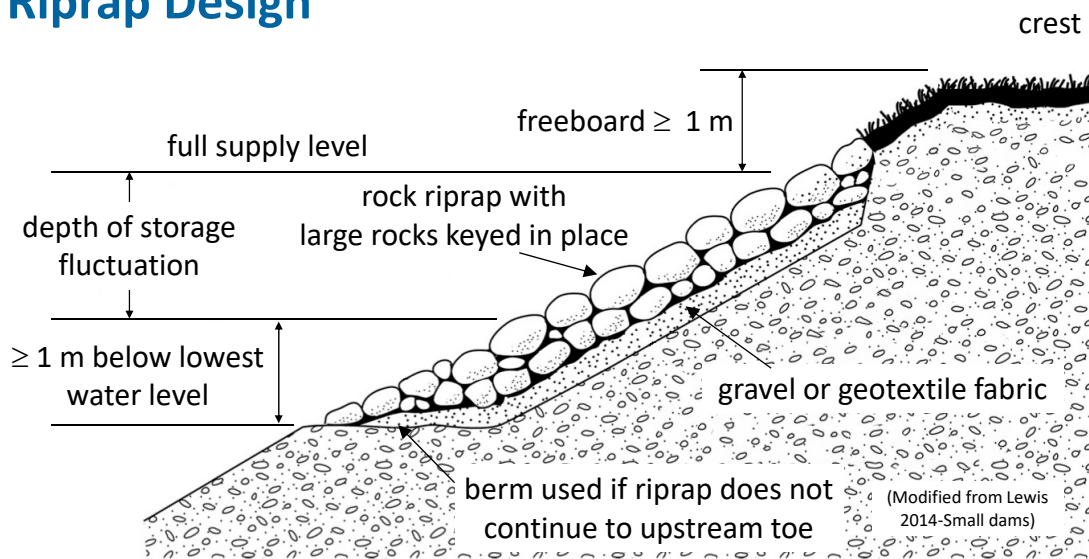
Wave height (m)	Layer thickness (m)	Rock diameter d_{50} (m)
0.30	0.3	0.20
0.55	0.4	0.25
0.80	0.5	0.30

Smallest rock ≥ 0.1 m

(Gerard Degoutte 2012, Small dams, guidelines for design, construction and monitoring, ICOLD Bulletin 91)

7

Riprap Design



See also http://www.env.gov.bc.ca/wsd/public_safety/flood/pdfs_word/riprap_guide.pdf

8

Displaced and Disintegrating Riprap



9

Geotextile Covers

- Attach to groomed ground surface with stakes



Improperly Installed Geotextile Covers





Log Booms

- Logs should be tied end-to-end as close together as practical and with enough slack to allow the boom to adjust itself



Log Booms

- Place boom close to the upstream face for best results
- Log diameter ≥ 0.3 m with holes bored at least 0.5 m from ends
- Boom chains or wire rope: 356 kN ultimate strength
- Anchors: buried lock blocks (min. 1.5 x 0.75 x 0.75 m, 2 t)

(FLNRO)

15

Booms



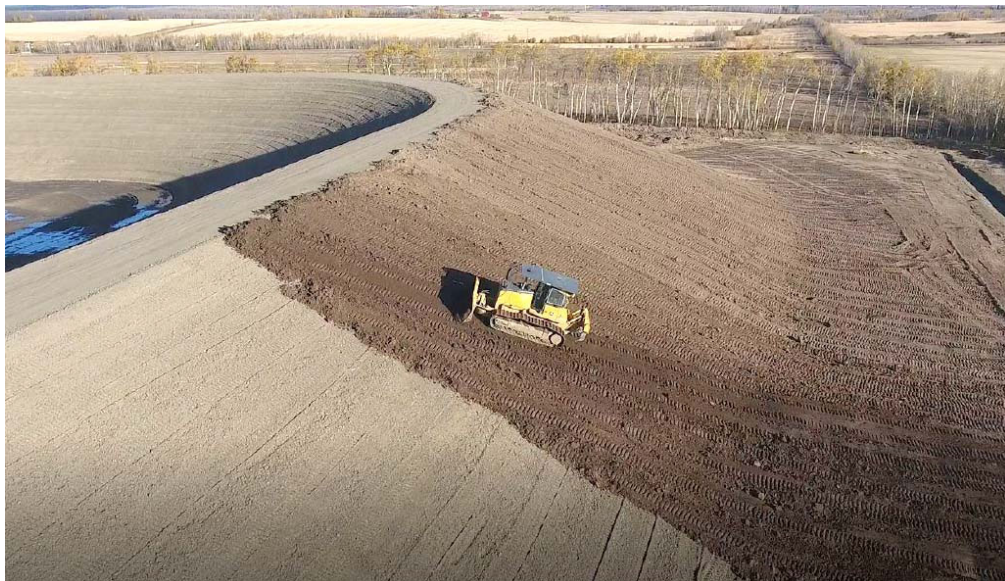
16

2 - Runoff Protection

- Topsoil and grass
- Mulch and seed
- Erosion control mats



Spread Topsoil



Topsoil

- Provides nutrients and organic soil to promote plant growth after seeding
- Reduces splash erosion by absorbing raindrop energy
- Reduces wide fluctuations in embankment moisture content
- Minimises surface cracking in the embankment

19

Topsoil

- Limited erosion control
- Not appropriate for slopes steeper than 2H:1V
- Dry topsoil may be removed by blowing wind

20

Mulch

- Straw, wood fibre, peat moss, wood chips...
- Provide temporary erosion protection
- Provides dust control and protection from wind erosion
- Relatively cheap
- May require spray-on method to apply mulch with tackifier to provide adhesion to steep slopes

21

Mulch

- Note cracks



22

Hydroseed – Hydromulch

- Relatively cheap and efficient method of spraying seeds to promote plant growth
- Inspect mulched areas at least once per year or after significant storm events
- Regrade areas damaged by surface erosion and cover with mulch
- Reseed and cover small bare spots with mulch

23

Hydroseed



Coconut Fibre & Synthetic Mesh

- Hi-tech mulch



25

Grass

- Establish and maintain dense cover of grass
- Effectiveness increases with time as grass grows
- Use regular mowing to restrict grass height <0.2 m
- No shrubs, trees



26

Excess Vegetation on Dam



27

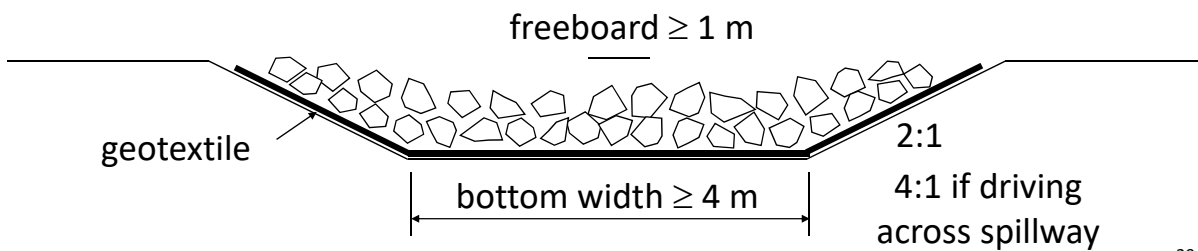
Spillway and Ditch Erosion Protection

- Riprap
- Gabions
- Grass

28

Spillway Design Considerations

- Gradient should be as flat as possible
- Normal freeboard ≥ 1 m, spillway width ≥ 4 m (FLNRO)
- Side slopes no steeper than 2:1 (FLNRO), 4:1 (Alberta Agriculture and Forestry)



29

Spillway Design Considerations

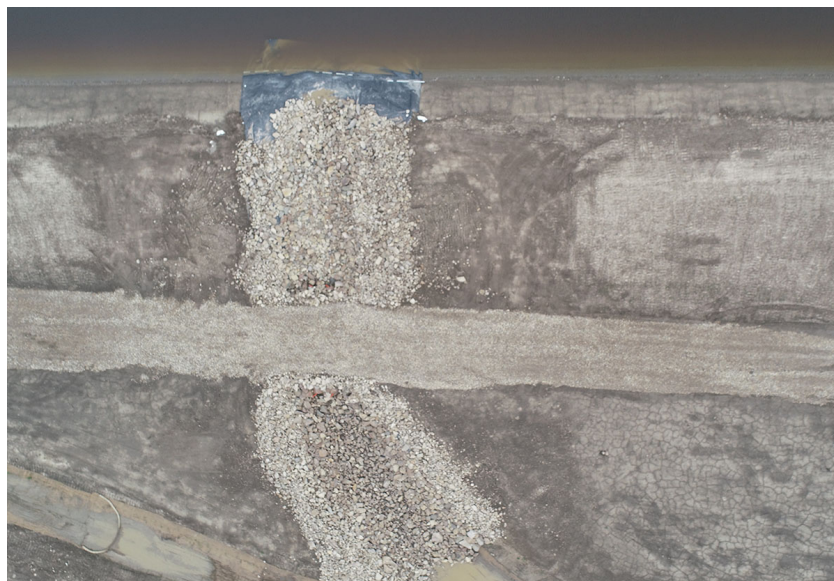
- Place spillway on native ground rather than dam embankment if possible
- Spillway should direct flow away from the toe of the dam to avoid embankment erosion during floods

30

Riprap on Spillway



Riprap on Spillway



Riprap on Inlet



33

Outlet Erosion Protection

- Place rock (dia. > 300 mm) on a layer of crushed rock
- Construct effective outlet structure to dissipate the discharge flow energy



https://stormwater.pca.state.mn.us/index.php?title=File:Example_of_riprap_outlet_protection.jpg

34

Riprap Missing Gravel or Filter Layer



35

Gabion Mats

- Use gabion mats if no large rocks are available



36

Ditch Erosion Control

- Riprap
- Gabions
- Check dams and energy dissipaters
- Erosion control mats
- Bio-engineering (vegetation)

37

Riprap Lining for Ditch Channel

- Thickness 1.5 to 2 × largest rocks or 1.5 to 3 × d₅₀
- Thickness > 300 mm



Water Velocity (m/s)	Mean Rock Diameter (mm)
<2.0	80 – 100
2.0 – 2.5	110 – 180
2.5 – 3.0	180 – 220
3.0 – 3.5	220 – 330

(Nova Scotia Department of Environment)

38

Non-woven Geotextile Filter Fabric for Ditches

	Class 1M, 1 & 2	Class 3
Grab strength	650 N	875 N
Elongation (failure)	50%	50%
Puncture strength	275 N	550 N
Burst strength	2.1 MPa	2.7 MPa
Trapezoidal tear	250 N	350 N

Minimum fabric overlap = 0.3 m

Alberta Transportation

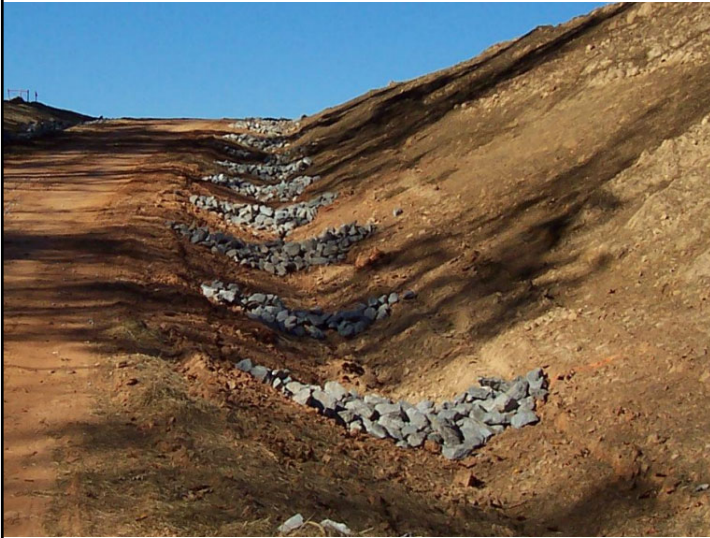
39

Geotextile Under Spillway Riprap

<u>PROPERTY</u>	<u>TEST METHOD</u>	<u>UNIT</u>	<u>REQUIREMENT</u>
Thickness	ASTM D5199	mm	3.5
Weight	ASTM D5261	g/m ²	407
Tensile Strength	CAN 148.1 No.7.3	N	1470
Elongation at Break	CAN 148.1 No.7.3	%	50 – 150
Trapezoid Tear	CAN 4.2 No.12.2	N	600
Mullen Burst	CAN 4.2 No.11.1	kPa	3500
CBR Puncture	ASTM D6241	N	4000 (average value)
Puncture	ASTM D4833	N	850
UV Resistance	ASTM D4355	% / 500h	50
Permeability	CAN 148.1 No.4	cm/s	0.190
Permittivity	CAN 148.1 No.4	s ⁻¹	0.41
FOS	CAN 148.1 No.10	µm	40 - 110

40

Check Dams & Erosion Control Mats



41

Erosion Control Solutions Exist

- Select the most appropriate ones to use
- Install them properly



42